

ORGANS OF IMMUNE SYSTEMS

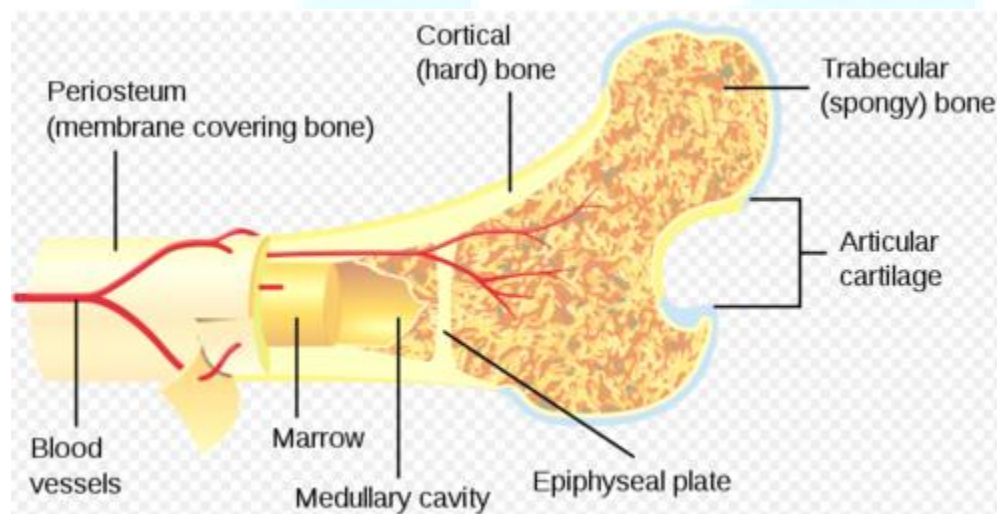
The Immune system functions throughout the body. There are, however certain sites where the cells of immune systems are organised into specific structures. These are classified as primary lymphoid tissues or central lymphoid tissues and secondary lymphoid tissues or peripheral lymphoid tissues.

A) primary lymphoid organs

Also called central lymphoid organs. These are responsible for synthesis and maturation of immune competent cells. Eg bone marrow and thymus.

Bone marrow

All cells of immune system are formed in bone marrow. During *hematopoiesis* (process of formation of blood cells), bone marrow stem cells develop into either mature cells or precursors of cells that migrate out of the bone marrow to continue their maturation elsewhere. **Bone marrow produce lymphocytes, granulocytes, monocytes and dendritic cells, red blood cells, platelets.**



Structure of bone marrow

Bone marrow has its own structure and system. Bone marrow cells need a scaffolding to help them organise and be systematic in the production and release of cells into blood stream. This scaffold is provided through three main structure, *the blood capillary network, venous sinuses and articular fiber framework*. In many bones the capillary network originated from a single artery which enters the bone close to its center. Inside the bone it divides and continues to subdivide along the length of the bone. Small capillary branches radiate off the larger blood vessels to reach the extremities of the bone marrow. These capillaries connect up with a second system of vessels called **venous sinuses**.

These venous sinuses are barrel shaped and expand and contract to accumulate the variable production and release rate of blood cells. The sinuses either have perforated walls or don't have walls. Blood cells that are ready to leave simply migrate to these sinuses and release themselves into sinuses.

General changes in the colour of the red marrow can sometimes be observed. Under challenge from chronic infection the red marrow changes to pale pink.

Thymus

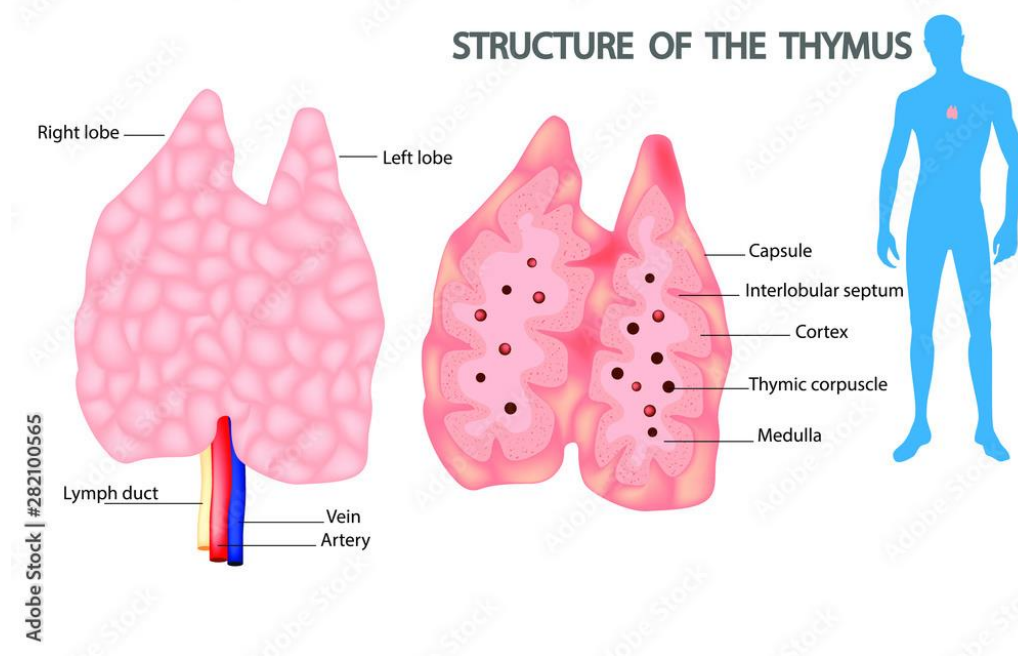
The thymus is believed to produce lymphocytes.

In humans, it is a bilobed structure and lies at the top of the heart at the vertical midline of the body in the thoracic cavity.

Lower parts of the lobes rest over the front of the heart and the top of the thymus wraps around the wind pipe. Each of the two lobes is enclosed in a capsule.

The lobe is divided up in a rough honeycomb structure by membranes called trabeculae or sometimes septa. Each division of the tissue by septa is a lobule. Each lobule has an outer layer called cortex consisting of cells which turn out to be lymphocytes mixed in with many blood vessels, and an inner core called medulla consisting of some lymphocytes but predominantly epithelial cells.

The blood vessels have several physical layers surrounding them called blood-thymus barriers. These barriers consist of membrane, connective tissue and cells which play an important part in restricting which cells are allowed to cross into the medulla of thymic lobules and which cells are flushed straight through the thymus.



B) Secondary lymphoid organs

Secondary lymphoid organs are the sites where lymphocytes localize, recognise the foreign antigen and mount response against it.

Spleen

Spleen made up of B cells, T cells, macrophages, dendritic cells, natural killer cells and red blood cells.

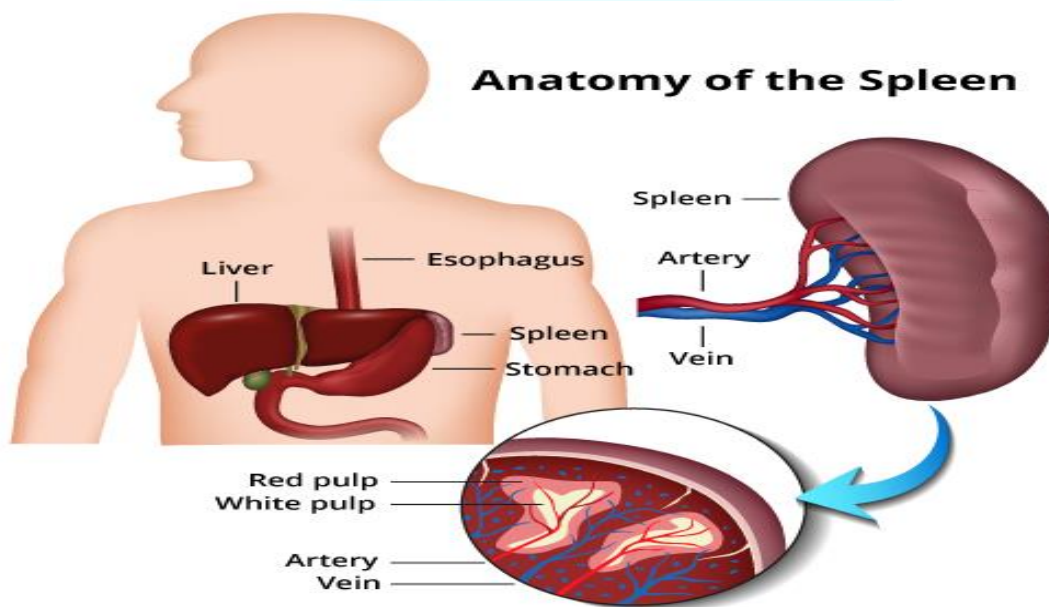
Spleen has a thin connective tissue capsule from which short septa extend inwards . These septa are in turn connected to a complex reticulin framework. There are two distinct components of the spleen, the red pulp and white pulp. The red pulp consist of large numbers of sinuses and sinusoids filled with blood and responsible for filtration function of the spleen. white pulp consist of aggregates of lymphoid tissue and is responsible for immunological function of spleen

Red pulp

There is a complex system of blood vessels with in red pulp arranged to facilitate removal of old or damaged red blood cells from circulation. A small proportion of the splenic blood flow passes through more rapidly with out undergoing filtration.

White pulp

It contain T cells and B cells. Purpose of white pulp is to generate an immunological response to antigens within the blood.



Lymph nodes

Lymphatic system parallels the circulatory blood systems. It is periodically guarded by lymph nodes, which are found throughout the body. Composed of mostly T cells, B cells, dendritic cells and macrophages.

Lymph nodes have 2 main functions

- Phagocytic cells act as filters for particulate matter and microorganisms.
- Antigen is presented to the immune system

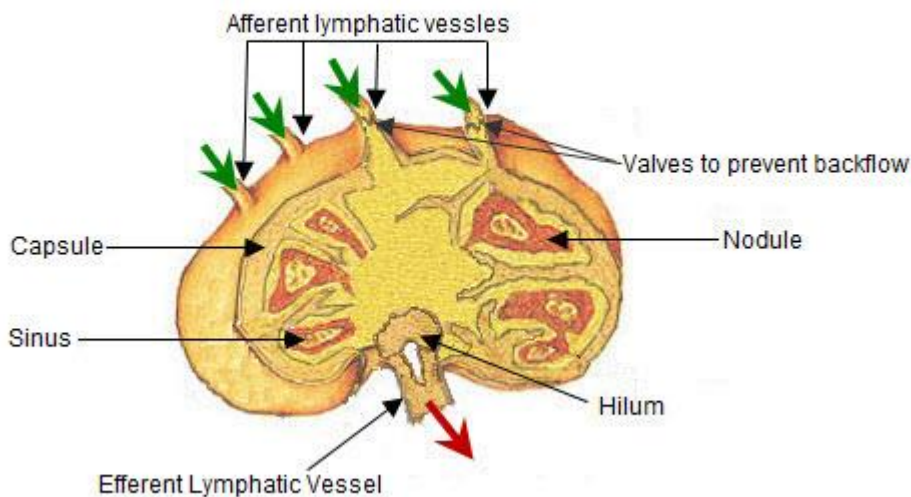
Lymph nodes have 3 components

Lymphatic sinus

Blood vessels

Parenchyma (cortex, paracortex, medulla)

Lymph Node Structure



Cortex

Cortex contains B cells and accessory cells

B cells enter the lymph nodes via high endothelial venules (HEV) and pass to the follicles. If activated, they proliferate and remain in the node. Activated B cells within a lymphoid follicle are called follicle center cells. The pale-staining central area of a secondary follicle is

known as germinal centre cells. The follicle centre cells with in the germinal centres consist of cells with cleaved nuclei (centrocytes) and cells with larger more open nuclei and several nucleoli.

Accessory cells

Lymphocytes need accessory cells to make immune response. They are

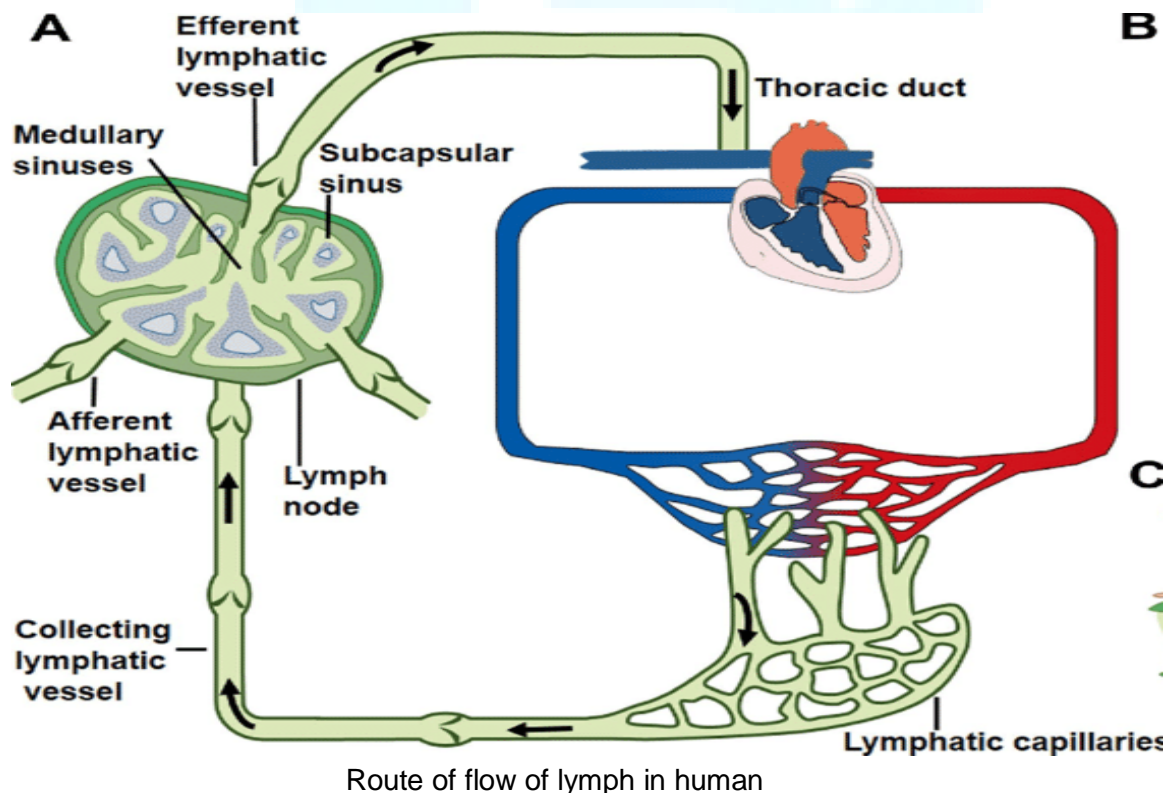
- Sinus macrophages
- Tingible body macrophages
- Marginal zone macrophages
- Follicular dendritic cells

Paracortex

It contain lymphocytes and accessory cells along with supporting cells and it is the predominant site for T lymphocytes with in the lymph node.

Medulla

- It comprises
- Large blood vessels
- Medullary cords
- Medullary sinuses



Mucosa associated lymphoid tissue

Lymphoid tissues are present in gastrointestinal tract, respiratory tract and urinigenital tract

Gut associated lymphoid tissue

Tonsils, adenoids

Peyer's patches

Lymphoid aggregates in the appendix and L.intestine

Lymphoid tissue in stomach

Small lymphoid aggregates in oesophagus

Peyer's patches

These are large aggregates of lymphoid tissue found in S.intestine. the over lapping dome epithelium contain large number of intraepithelial lymphocytes. Some of the epithelial cells have complex microfolds in their surfaces. They are known as M cells and are belived to be important in the transfer of antigen from the gut lumen to Peyer's patches. Peyer's patches facilitate generation of an immune response within the mucosa.

